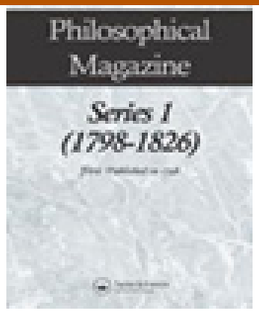

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XLII. On the combination of antimony with tin

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but by a great quantity of potash; it is sufficient to boil the liquor some time in order to burn the hydro-sulphuret; and, besides, the sulphurated hydrogen is separated by the acid of the alum. In short, the operation would be very much abridged, if, instead of washing the prussiate of iron in a great quantity of water, it was only mixed with a small quantity of oxygenated muriate of lime.

Such are the observations which I considered it my duty to collect in the present memoir; the whole facts do not belong to my subject. In order to support those which do, I have connected with them some observations which were the result of the labours of different chemists. Sometimes I have even repeated facts known long ago, in order to present at one view the properties of a body, or the track we ought to follow in an operation. Yet still, I believe, I have examined, with some advantage to the arts and sciences, the oxidation of iron and the combinations of its oxides with acids. The existence of the white oxide of iron will make us acquainted with various phænomena the causes of which were hitherto unknown; it explains, in particular, that variety of colours which all the ferruginous salts present to us. It spreads some light on one of the finest and most important dyes known, viz. that of black. It does not throw less light on the manufacture of Prussian blue, upon the improvement of which much yet remains to be done. In short, it deeply concerns the art of obtaining sulphate of iron, the perfection of which becomes daily more and more desirable.

XLII. *On the Combination of Antimony with Tin.* By M. THENARD *.

I WAS led, about a year ago, to make the observations I am now about to communicate, upon examining an alloy attempted to be introduced into commerce, and to which such miraculous properties were improperly attributed, that, according to some accounts, it might have been substituted in place of silver.

* From *Annales de Chimie*, tome lv.

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It was said to be very malleable; but, above all, its admirers boasted of its inalterability. By its appearance I thought that it contained plenty of tin; and as the price of it was moderate, I presumed it also contained antimony, and, to a certain degree, zinc or lead also. This was the reason why I treated 100 parts of it with the nitric acid. This portion of it was immediately attacked by a violent effervescence, and converted into a white powder. At the end of half an hour's ebullition, after having filtered the liquor, I tried it successively by the potash of commerce, the sulphuric acid, and the hydro-sulphurets.

All these re-agents having indicated that it contained nothing metallic in solution, I thought it very probable that this alloy was composed of tin and antimony alone. In order to ascertain this completely, I took the above white powder produced by the nitric acid, and I dissolved it in the muriatic acid. I concentrated the solution, and diluted it with water. It produced, as I had previously conjectured, a very abundant precipitate; but having allowed the liquor to settle a whole day, and having decanted it, I found no more metallic traces than in the preceding. Ammonia scarcely troubled it at all, and the hydro-sulphuret of potash gave it a slight yellow colour. Although I had performed the operation with much care, I could not at first give credit to this result, it appeared so singular, and it was only by repeating it that I found I was not deceived. What ought I to conclude from this? Had I consulted only the known properties of the oxides of antimony and tin, I should have been led to believe that the substance I had examined was nothing but antimony. It was however sensibly malleable, and must therefore have contained another metal. Every thing led me to believe that this was tin; and, in fact, I actually formed an alloy with antimony and tin, which enjoyed all the properties of the one above described. Four parts of tin and one of antimony give a very ductile alloy. Equal parts of each also give an alloy which possesses still a certain ductility. But if a few centiemes of lead enter into the tin, both the above alloys become very brittle. The intermediate alloys possess properties relative to the quantities of

of tin and antimony which constitute them. All of them are not precipitated from their solution in the nitro-muriatic acid by means of water. There are, necessarily, limits; but these limits are very distant. It is necessary for the alloy to contain one-third of its weight of antimony to have this property, particularly if the excess of acid has been in a great measure driven off by evaporation. I ought, however, to notice that the precipitation is not completely made in less than 24 hours, when antimony predominates; because then the latter portions, which are a combination of the two oxides with the muriatic acid, only separate by little and little.

This is not, however, the only example we have of combinations of oxides. We cannot doubt that the oxide of tin does not combine with the oxide of lead; for on calcining an alloy of three or four parts of lead and one part of tin, it soon burns in the manner of a pyrophorus, and is converted all at once into oxide; while tin, much more combustible than lead, far from presenting this sort of phænomenon, does not transform itself into putty but after a long time, even by multiplying its points of contact with the air. I made several other trials in order to ascertain if the oxide of antimony would act upon other oxides as well as upon the oxide of tin. I think I ascertained that the latter is the only one which the antimonial oxide takes with it in precipitation, and that the oxide of bismuth does not precipitate any oxide along with itself, not even the oxide of tin.

After having thus proved synthetically that my alloy was formed of tin and antimony, I proceeded to inquire after the analytical means proper to produce the separation of these two constituent principles. I then employed the muriatic acid, which dissolves tin very well, and does not attack the oxide of antimony. It had hardly any action upon the alloy; and, besides, in the portion dissolved I found antimony. I next tried sulphurated hydrogen. I knew that it would easily precipitate the muriate of antimony; and that, on the contrary, it would not decompose but with difficulty the highly oxidated muriate of tin. This method had no more success than the former.

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The liquor concreted in a mass, and did not admit of my obtaining the salt of tin by itself; and even the separation was far from being exact. I tried also, but always without effect, to volatilize the antimony, by heating the alloy strongly in close vessels. Finally, I treated the alloy with nitro-muriatic acid, and I did it in such a manner that the two muriates were highly oxidated. I distilled them in a retort, taking care to agitate it incessantly in order to avoid the boiling over, particularly at the end of the operation. I urged the fire even until the bottom of the retort was red, and I obtained sensibly all the muriate of tin. The muriate of antimony, which when highly oxidated is not volatile, remained in the retort. A very small quantity of this salt alone had passed into the receiver. The muriate of tin also is scarcely troubled by means of water. Although this process was perhaps not very rigorous, in order to separate the two oxides of tin and antimony, I look upon it as the best hitherto employed, and I consider it good enough to indicate how many centiemes of tin are contained in antimony, or *vice versâ*.

The consequences which may be drawn from this new fact, important enough to merit the attention of chemists, are evident. Is it well ascertained that the mines of antimony do not contain tin, and *vice versâ?* Certainly not, because the methods of analysis hitherto practised to separate these two metals have been inexact. Already have I searched for tin in sulphuret of antimony, and I never discovered a single trace of it; but I have not yet analysed any other ores of antimony, nor of tin. It is a labour which appears to me very useful to make, and which perhaps would furnish interesting results.

XLIII. *Abridg-*